

Description of Additional Supplementary Files

Supplementary Data 1

Description: The TCGA samples included in this study and their corresponding 9p21 status. 9p21-WT: tumors with diploid/wildtype 9p21; 9p21-LOH: tumors with LOH (loss of heterozygosity) at both *CDKN2A* and *MTAP* locus. 9p21-Gain: tumors with copy number gain or amplification at 9p21. 9p21-Loss: tumors with homozygous deletion of 9p21.

Supplementary Data 2

Description: The TCGA disease codes and other abbreviations.

Supplementary Data 3

Description: The TCGA cohorts with frequent 9p21 loss (>10%).

Supplementary Data 4

Description: The spatial immune cell patterns and 9p21 loss.

Supplementary Data 5

Description: Summary of TCGA samples with image data.

Supplementary Data 6

Description: The immune cell abundance and 9p21 loss. P values were calculated by two-sided Wilcoxon rank-sum test and adjusted with the Benjamini-Hochberg method.

Supplementary Data 7

Description: The curated gene sets for immune signaling pathway analysis.

Supplementary Data 8

Description: The aberrant immune signaling pathways associated with 9p21 loss. P values were calculated by two-sided Wilcoxon rank-sum test and adjusted with the Benjamini-Hochberg method.

Supplementary Data 9

Description: The immune modulatory genes used in this study.

Supplementary Data 10

Description: Summary of the 8 ICT trials included in this study.

Supplementary Data 11

Description: The MDA solid tumor cohort, anti-PD-1/L1 monotherapy.

Supplementary Data 12

Description: The MDA mUC cohort, anti-PD-1/L1 monotherapy. DSS (days): Disease-specific survival interval in days. PFS (days): Progression-free survival interval in days.

Supplementary Data 13

Description: The MSK NSCLC cohort from Rizvi et al.

Supplementary Data 14

Description: The Metastatic urothelial cancer (mUC) cohort from Mariathasan et al.

Supplementary Data 15

Description: The MCP-counter immune deconvolution results for the mUC cohort from Mariathasan et al..

Supplementary Data 16

Description: The CIBERSORT immune deconvolution results for the mUC cohort from Mariathasan et al..

Supplementary Data 17

Description: List of immune-related genes and therapeutic targets.

Supplementary Data 18

Description: The differentially expressed genes (DEGs) in 9p21-loss tumors in the mUC cohort from Mariathasan et al..

Supplementary Data 19

Description: Genes of interest (Supplementary Data 17) that showed significant correlation with *CDKN2A/MTAP* expression in the mUC cohort from Mariathasan et al..

Supplementary Data 20

Description: Genes of interest (Supplementary Data 17) that showed significant correlation with *CDKN2A/MTAP* expression in TCGA cohorts.

Supplementary Data 21

Description: Genes located at 9p21.3 loci.